REPORT ON A BONE BRECCIA DEPOSIT NEAR THE WOMBEYAN CAVES, N.S.W.:

WITH DESCRIPTIONS OF SOME NEW SPECIES OF MARSUPIALS.

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(Plates vi.-viii.)

About 18 months ago I discovered a small bone breccia deposit in the neighbourhood of the Wombeyan Caves. The deposit is situated in a small depression near the top of the hill above the present caves and no doubt is portion of the floor of an older cave whose walls and roof have long since been weathered away. The deposit consists of a rather hard light brown calcareous matrix containing imbedded in it innumerable small bones. In some parts the bones are almost all small and packed together so closely that there is very little matrix; in others the matrix is comparatively free from bones, only containing a few of the larger forms. As the deposit is unquestionably old and contains some forms new to science—two of which I have already described*—I have thought it well to give a detailed account of the forms found, as it will give a fair idea of the smaller animals living in later Tertiary times.

Macropus (Halmaturus) wombeyensis, n.sp.

(Pl. vi. figs. 1-3).

Though the deposit is essentially one of small bones, there are a number of bones of a species of *Macropus*. Besides a number of vertebræ and long bones, I have succeeded in finding three imperfect fragments showing the upper molars, and four moderately well preserved lower jaws—two of which are presumably from the same individual. In size the form was apparently

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* Proc. Linn. Soc. N.S.W. (2) Vol. x. (Pt. iv. 1895).

about that of *Macropus ualabatus*, but the dental details are decidedly different. Of existing species the only one to which it comes at all close is *M. agilis;* but from this species it differs in the narrowness of the molars and in the jaw being considerably thinner. Among extinct forms the only ones approaching it in dental details and measurements are some fragmentary specimens from Queensland, referred to by De Vis.* Thinking my form might possibly belong to the same species as one or other of the fragmentary Queensland specimens, I submitted a specimen to Mr. De Vis, who kindly writes me as follows:—"I have compared the Halmaturus jaw with my types—it agrees with none of them. In size and general features it is like *H. agilis*, but appears to me to be quite distinct from that species." As my specimens thus appear to differ from all existing or previously observed extinct species, I have conferred on it the above distinctive name from the locality in which the form has first been observed.

In general form the lower jaw resembles that of the larger Wallabies; there is, however, a greater disparity between the anterior and posterior depth of the jaw than is usually the case in existing forms. The dental portion of the jaw is comparatively narrow—more so than in any of the existing larger Wallabies. The angle is more inflected than in the Wallabies, closely resembling the condition in the Rock-Wallabies. The premolar (p^4) is well developed, rather narrow without internal cusp. It is slightly ridged, there being three very shallow vertical grooves. In the specimen figured (Pl. vi. fig. 3) there are also on the outer aspect two small horizontal furrows. The molars resemble very closely those of *M. ualabatus*—the crests being curved and the links well developed.

Though two specimens illustrate the palatal region, in neither are the teeth well preserved. The upper premolar (p^4), however, appears to have had a moderate internal cusp. One point of great interest is the presence of large palatal vacuities. In this

* Proc. Linn. Soc. N.S.W. (2) Vol. x. (Pt. i. 1895).

the form agrees with the smaller Wallabies and Rock-Wallabies and differs from the larger sorts.

Though the form thus equals in size the larger Wallabies, its affinities are probably more with the smaller sorts, and in some respects it seems to come very near to the Rock-Wallabies *(Petrogale)*.

The following are some of the principal measurements :—

Depth of mandibles behind p^4 (4 sp.), 17, 18, 18·4, 18·4 mm.
„ „ in front of m^4 (3 sp.), 15·4, 16·9, 16·9 mm.
Length of p^4 (2 sp.)... 6·8 mm. (worn), 7·4 mm. (unworn).
„ m^1-m^2 (2 sp.)...13·4, 13·5 mm.
„ m^1-m^3 (2 sp.)...21·8, 21·9 mm.
„ m^2-m^4 (2 sp.)...25, 26 mm.
„ m^1-m^4 (3 sp.)...29·2, 30·8, 31·4 mm.
„ m^3-m^4 (3 sp.)...17·8, 18·, 18·8 mm.
„ p^4-m^4 (3 sp)...36·5, 37, 37·4 mm.
Width of m^3 (3 sp.)...5·7, 5·8, 5·8 mm.
Thickness of mandible below m^3, 9·3 mm.

Potorous tridactylus, var. antiquus, n.var.

In the deposit are the remains of a small Potorous. Though not abundant a number of specimens have been obtained. As I have been unable to obtain a skull of the existing *Potorous tridactylus* I am in some doubt as to the exact position of the fossil form. *Potorous tridactylus*, as defined by Thomas, is apparently a very variable species, and it seems probable that the fossil form is but a variety. As regards the premolar of this species Thomas (Brit. Mus. Cat. Marsup.) says:—"P^4 very variable; in the large Tasmanian form ('*apicalis*') 7 or 8 millim. long, with four distinct grooves; in the smaller New South Wales examples, and in the still smaller Tasmanian form described as '*rufus*' 6 or 7 millim. long with only three grooves." In the fossil form the upper premolar measures 6·1 mm., but has four grooves. The three anterior grooves are well marked, but the fourth, though well marked at the edge, does not extend so far up the tooth as the others. In the deciduous p^3 there are but three grooves. In the lower p^4 there are four grooves, all well developed.

Dental Measurements.

Length of upper p^4 ...6·1 mm.
,, ,, dp^4...3·4 mm.
,, ,, m^1 ...4·8 mm.
,, ,, m^2 ...4·9 mm.
,, lower p^4 ...5· mm.

Burramys parvus, Broom.

(Pl. vii. figs. 1-2).

This most interesting little form which I recently described before this Society * occurs in the deposit pretty abundantly, but from its minute size and the obliquity of the large premolar it is difficult to extract perfect specimens. Since I described the form I have succeeded in discovering a few more points in its structure. In my paper on this species I expressed the opinion that it forms a connecting link between the Phalangers and the Kangaroos, finding in the large grooved premolars a relationship with the Rat-Kangaroos and in the entire masseteric fossa, and the small teeth between i^1 and p^4 an affinity with the Phalangers. No perfect specimen has yet been discovered of the upper jaw, but a few fragmentary specimens enable us to almost complete the dental formula. Within the upper large premolar and a little in front is a minute two-rooted premolar similar to p^3 in the lower jaw. In front of this is a very considerable diastema where the palate has a rounded edge somewhat like that in Macropus, and with apparently no anterior premolars. In front is a small but well formed canine implanted in the maxillary more after the manner of the small Macropods than of the Phalangers. The dental formula so far as known would thus appear to be, in the notation used by Thomas :—

$$I\ \frac{\cdot\ \cdot\ \cdot}{1\ 2\ 0}\quad C\ \frac{1}{0}\quad P\ \frac{0\ 0\ 3\ 4}{1\ 0\ 3\ 4}\quad M\ \frac{1\ 2\ 3\ 0}{1\ 2\ 3\ 4}$$

* "On a small fossil Marsupial with large grooved premolars." Proc. Linn. Soc. N.S.W. (2) Vol. x. (Pt. 4, 1895).

There appears to be no upper m^4, while the rudimentary lower m^4 is apparently variable. The dental formula shows much resemblance to that of *Hypsiprymnodon* as regards the upper teeth, but in the possession of the two small teeth between i^1 and p^3 there is considerable difference in the lower jaw. As regards the number and arrangement of the teeth in the lower jaw the agreement with some of the smaller Phalangers is very marked; *Dromicia nana*, for example, having an entire dental formula almost exactly like that of *Burramys*. To *Dromicia nana* there is also a marked resemblance in the lower minute teeth and some resemblance in the molars.

A considerable fragment of the skull gives a fair idea of the outline, but adds little to the settlement of the affinities of the genus. The skull has been apparently sharp-snouted as in *Petaurus* or *Dromicia*. The lacrymal foramen is placed distinctly in front of and beyond the orbit. The infraorbital foramen is large, and placed in front of the large premolar—in this resembling the condition in the Phalangers and differing from the normal Macropod arrangement. The interorbital region of the skull is comparatively broad, but there is no distinct supraorbital ridge. The olfactory lobes of the brain have been well developed, and the whole brain appears to have been relatively large. The zygomatic arch passes out from the maxilla in the usual manner: it arises near the posterior part of the large premolar and is com paratively slender.

Petaurus breviceps, Waterh.

Some time ago I found an imperfect fragment of a lower jaw, with the roots of three teeth in position. Though the fragment was manifestly that of a Petaurus and in size agreed with *P. breviceps*, I hesitated to refer it definitely to that species on such imperfect evidence. Since then I have found a fragment of the cranium with the frontal bones almost perfect, and from the size and the formation of the supraorbital ridges, there is no doubt in referring the specimen to *P. breviceps*, and there is little doubt but that the lower jaw fragment also belongs to this species.

As these are the only remains found the species must have been very rare in the district at the time of the deposit.

At present the species is found in the district and may be regarded as not infrequent, though I am led to believe that 50 years ago it was very abundant, the present scarcity being due apparently to the havoc made amongst them by domestic cats.

Palæopetaurus elegans, Broom.

(Pl. vii. fig. 3).

This small Petaurus-like Marsupial I recently described* from some jaws and a well preserved specimen with the maxillary teeth. Since then I have found besides numerous jaws a moderately good portion of the skull (Plate , fig. 3) and a number of other fragments. The frontal bones differ from those of *Petaurus*, and agree apparently with *Gymnobelideus* in being without supraorbital ridges; and the hinder part of the frontals is considerably broader and flatter proportionally than in *Petaurus*. The snout though narrow appears somewhat broader than in *Gymnobelideus* judging by the figure. In one of the type specimens the upper p^1 was found to be single-rooted, or rather its two roots were united together. This, too, appears to be rather variable as in two other specimens one is found with the roots close together but distinct, while the other has the roots somewhat apart. In all the observed specimens, however, p^3 is double rooted.

Dromicia nana, Desm.

One of the most interesting discoveries is that of *Dromicia nana*, of which I have found a large number of both lower and upper jaws. There can thus be little doubt but that in later Tertiary times *Dromicia nana* was very common in New South

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* "On a small fossil Petaurus-like Marsupial," Proc. Linn. Soc. N.S.W. (2) Vol. x. (Pt. 4, 1895).

Wales. From the existing species being believed to be confined to New Guinea, Tasmania, and West Australia, Thomas regards it as practically certain that *Dromicia* existed in former times in Eastern Australia. The correctness of this conclusion is now established. The fossil form so far as known does not differ from the existing *D. nana*.

As regards the present distribution of this species Thomas considers it to be exclusively confined to Tasmania. In this, however, it is probable that he is in error. For though the species must be excessively rare in New South Wales it most probably still survives, as it is quite certain that it existed within very recent years. In the Grand Arch at the Wombeyan Caves there are near the entrance numerous ledges of rock frequented by Rock Wallabies, and on which the animals leave quantities of their excrement. Mingled with the dry and decomposing dung are to be found quantities of small bones—chiefly those of *Phascologale flavipes*, *Petaurus breviceps*, and of the Bush Rat (*Mus* sp.), but with also a few of *Pseudochirus peregrinus*, *Perameles obesula*, and of small birds and snakes. While searching among these I discovered, to my surprise, two jaws of *Dromicia nana* in tolerably good preservation. It is hard to say what may be the age of the bones, but as the ledge is quite exposed to atmospheric influences and as the bones show little sign of weathering, it cannot well be more than a very limited number of years since the animals died. Considering the wild region in which the caves are situated it is very probable that the species still survives in the district, though I have sought it in vain. On mentioning my discovery to Mr. J. J. Fletcher, he kindly called my attention to Krefft's discovery of *Dromicia unicolor* [= *D. nana*] at North Shore, Sydney, in 1863, and to the fact that Thomas regards the specimens as almost certainly Tasmanian specimens which had escaped from captivity. Such an explanation will not do for the recent bones found at the Wombeyan Caves, nor is such a theory now required for even Krefft's specimens, considering that in former times *Dromicia nana* was one of the commonest of New South Wales marsupials.

Pseudochirus antiquus n.sp.

(Pl. vii. Figs. 4-6).

One of the commonest forms whose remains are found in the deposit is a species of *Pseudochirus*. In size and structure it much resembles the common ring-tailed Phalanger (*P. peregrinus*), but the careful study of a large series of specimens has satisfied me that the remains are those of a distinct and new species. In average size the teeth are appreciably larger than in *P. peregrinus*, yet on the whole the form comes nearer to that species than to either *P. cooki* or *P. orientalis*.

The following table illustrates the features so far as known and the points distinguishing the fossil form from *P. peregrinus*.

P. peregrinus.	*P. antiquus.*
Upper p^1 small, about 1 mm. in front of p^3	Upper p^1 moderate size, placed close to p^3
Length of m^1-m^3 — 11·2-12·6 mm.	m^1-m^3 in only three specimens, showing complete series— 12.7, 12·9, and 13· mm.
Cusps of upper and lower molars moderately developed	Cusps of upper and lower molars well developed
Post. Ext. Cusp of upper m^1 (4 sp.) min. 1·7, max. 2·0, average 1·85	Post. Ext. Cusp of upper m^1 (5 sp.) min. 2·1, max. 2·3, average 2·22
Ant. Int. Cusp of lower m^4 (3 sp.) min 1·6, max. 1·8, average 1·7	Ant. Int. Cusp of lower m^4 (3 sp.) min. 2·3, max. 2·5, average 2·4
Palate with a distinct lateral depression in region of p^3 and p^4	Palate moderately flat, no distinct lateral depression in region of p^3 and p^4
Angle of jaw produced well backwards.	Angle of jaw relatively small and passing backwards but a short distance

It is unfortunate that I have not succeeded in getting any specimens with the upper p^1 in position, and only one specimen (Pl. fig. 4) showing the socket. From this specimen the tooth appears to have been almost double-rooted and placed much closer to p^3 than in *P. peregrinus*, and in this resembling more *P. cooki*.

PERAMELES WOMBEYENSIS, n.sp.

(Pl. VIII. figs. 1-8).

The above name I propose for a species of *Perameles* which must have been very common at the period when the bone deposit was formed. Though from the nature of the matrix I have been unable to develop a single perfect jaw, yet I have succeeded in finding sufficient fragmentary specimens to enable me to give almost all the important details of dentition. The species seems to have been a form a little larger than *P. obesula*, and to have resembled it in being short-nosed.

The upper incisor teeth are unknown, the premaxillary being absent from all the upper jaw specimens I have. The canine is moderately developed and rather larger and flatter than in *P. obesula*. P^1 is considerably larger than in *P. obesula*, and directed somewhat forward. It is placed about 2 mm. behind the canine. P^3 is about equal in size to p^1 and placed a little less than 1 mm. from it. It has a distinct anterior secondary cusp and a less marked posterior one. P^4 is unknown. The upper molars resemble those of *P. obesula* in being soon worn down, and in old specimens leaving no trace of the cusps. In shape there is considerable agreement with those of *P. obesula*, the section of the worn tooth being quadrangular, with rounded angles. M^4 is unknown.

The lower jaw bears more resemblance to *P. obesula* than any other existing form. The anterior edge of the coronoid process is straight and the process itself passes back obliquely. The angle seems less produced than in *P. obesula*, though it is possible a portion of the slender tip may have been broken off in the figured specimen (Pl. fig. 1). The lower incisors are absent, but in fig.

3 the anterior part of the jaw is seen. The canine appears to be small, though as the specimen figured (Pl. VIII. fig. 3) is from a young animal, the canine has probably not attained its full size. P^1 and p^3 resemble the upper teeth in size, and are both furnished with small anterior and posterior secondary cusps. P^4 is relatively large. Lower molars resemble those of *P. obesula*.

The following are some of the principal measurements :—

Height of canine	3·1 mm.
Length of p^1	2·8 mm.
,, unworn m^1	4·0 mm.
,, worn m^2	3·6 mm.
,, worn m^3	3·4 mm.
Estimated length of unworn m^1-m^3 ...	11·3 mm.
Lower p^3-m^4, aged specimen	21·3 mm.
Estimated upper c-m^4	28-28·5 mm.

Thylacinus cynocephalus, Harris.

Of this species I have found two teeth—a perfect lower canine and a perfect lower premolar—but no bones.

Phascologale flavipes, Waterh.

This small pouched mouse is represented by a very large number of jaws and other remains. It appears to be the commonest species in the deposit with the exception of the Bush Rat. So far as I have been able to make out, the fossil animal in no way differs from the existing species. *Phascologale flavipes* is still found in the district, and though it is very rare if not extinct in the settled parts, in the wilder regions it is fairly common.

Phascologale penicillata, Shaw.

This species though met with is distinctly rare. I have only found one complete lower jaw, a fragment of a second, and two fragments of the upper jaw. The anterior premolars and canine are a trifle larger than in the recent skull in my possession (a female), but there is no doubt that the remains belong to the

existing species. The form is still met with in the district, though by no means common even in the mountainous regions, while in most of the settled parts it appears to be extinct.

Echidna sp.

(Pl. viii. figs. 9-10).

A number of bones of a large Echidna have been found, and which in all probability belong to the described form *Echidna oweni*, Krefft. The specimens are, however, too fragmentary to enable me to refer them definitely to this form. The remains comprise the greater portion of the left ilium, with a fragment of the sacrum attached, the lower portion of left femur, the articular head of the femur, two vertebral centra, and a number of fragments of long bones.

The femur differs in one or two respects from *E. aculeata*. The constriction of the shaft immediately above the condyles is much less marked, and the shaft at this part is more flattened than in the common existing species, while the depression above the patellar surface is more marked and broader.

The ilium is very considerably stouter proportionately than in *E. aculeata*. From the union by complete anchylosis of two small fragments of the sacrum with the ilium it is evident that the extinct species agrees with the living in the complete anchylosis of the sacrum with the ilia.

Max. width across lower end of femur	32·5 mm.
,, ,, ,, . in *E. aculeata* (adult male) ...	22·5 mm.
Oblique measurement from outer depression of shaft to inner condyle	26·4 mm.
Oblique measurement in *E. aculeata*	17·8 mm.
Trans. measurement above patellar depression ...	24· mm.
,, ,, ,, in *E. aculeata*	14·5 mm.

Besides the above forms there are a few remains too fragmentary for certain identification. Two fragmentary teeth probably represent *Thylacoleo*, while a detached molar belongs to a small species

of *Macropus*. There are also innumerable remains of Bush Rats (*Mus* sp.) which I have not had an opportunity of identifying with certainty. Of birds there have been found the perfect cranium of one about the size of a Sparrow and some small bones, while of lizards there occur the remains of a moderate sized member of the *Scincidæ*.

CONCLUDING OBSERVATIONS.

Though a few of the forms found in the deposit are still surviving, the general character of the fauna is very different from that of recent times. With the exception of *Thylacinus*, the *Macropus* and the *Echidna*, the animals may almost all be classed as feeble and defenceless, and have apparently flourished owing to the absence or scarcity of natural enemies. *Dromicia*, *Palæopetaurus* and *Burramys* were probably all of very similar habits, the conditions suitable to the one being equally so to the others, while those inimical to any would probably tend to the destruction of all. The two species of *Phascologale*, though probably suffering from the same adverse condition which has destroyed the small Diprotodonts. have been less affected and able to survive. The cause of the destruction of the smaller forms is probably to be found in the introduction into their midst of some common enemy. A glance at the recent fauna of the district suggests a not improbable explanation of the change. To-day the forms which may be said to be numerous are *Trichosurus vulpecula*, *Phascolarctus cinereus*, *Dasyurus viverrinus*, *D. maculatus*, and *Macropus ualabatus*. All these are absent from the deposit, and though their absence does not prove that they were not then in the district, it may safely be taken to indicate that they were at least rare. The absence of the common Phalanger for example could not have been due to unfavourable conditions, as the abundant remains of the species of Ring-tailed Phalanger show there must have been plenty of suitable trees. The conclusion thus seems probable that *Trichosurus* is a comparatively recent addition to the local fauna. If it could be proved that with it came the Dasyures we would have at once a

satisfactory explanation of the disappearance of the small Diprotodonts. It is at present, however, impossible to say more than that at the time of the deposit Dasyures were absent or rare, that in more recent times they have become numerous in the district, and that their introduction or increase has been the probable cause of the destruction of the smaller forms. The fact of *Petaurus breviceps* having not only survived but increased, while the closely allied *Dromicia* has been all but exterminated, seems to suggest that the former with the parachute expansions was able to escape from some enemy to which *Dromicia* fell a prey. *Palæopetaurus*, if we may assume, as is quite probable, that it resembled *Gymnobelideus* in being without lateral expansions, would fall as easily a prey as *Dromicia*.

I must acknowledge my indebtedness to Mr. J. J. Fletcher, Mr. R. Etheridge, Junr., Mr. De Vis, and to my father for kind assistance they have rendered me.

EXPLANATION OF PLATES.

Plate VI.

Macropus wombeyensis.

Fig. 1.—Right jaw—nat. size.
Fig. 2.—Right lower teeth—nat. size.
Fig. 3.—Lower p^4 (× 3).

Potorous tridactylus, var. *antiquus.*

Fig. 4.—Left upper molars (× 4·5).
Fig. 5.—P^3 (left upper?) (× 4·5).
Fig. 6.—Left upper p (4·5).
Fig. 7.—Right lower p^4 (× 5).

Plate VII.

Burramys parvus.

Fig. 1.—Side view of skull of (× 3·4). The lower jaw is seen somewhat obliquely to represent its true side view when placed in the skull.
Fig. 2.—Upper aspect of fragment of skull (× 3·4).

Palæopetaurus elegans.

Fig. 3.—Upper aspect of fragment of skull (× 2).

Pseudochirus antiquus.

Fig. 4.—Upper premolars (× 3·6).
Fig. 5.—Lower m^3 (× 4).
Fig. 6.—Back part of lower jaw—nat. size.
Fig. 7—Exactly similar aspect of lower jaw of *Pseudochirus peregrinus*.

Plate VIII.

Perameles wombeyensis.

Fig. 1.—Back part of lower jaw with m^4 (× 2).
Fig. 2.—Anterior part of upper jaw (× 2).
Fig. 3.—Inner view of anterior part of lower jaw of young—nat. size.
Fig. 4.—Inner view of adult lower jaw—nat. size.
Fig. 5.—Right upper m^1 unworn (× 4).
Fig. 6.—Left upper m^2 somewhat worn (× 4).
Fig. 7.—Inner view of lower m^4 (× 5·5).
Fig. 8.—Outer view of lower m^4 (× 5·5).

Echidna sp.

Fig. 9.—
Fig. 10.—